Tissue mechanics regulate brain development, homeostasis and disease.

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Public Summary:
The cells that make up the tissues and organs of our body are sensitive to both mechanical and chemical cues in their environment. Disease can develop when either of these types of cues go awry, or when cells respond to them inappropriately. For instance, diseases such as cancer can arise and/or progress when the fluid pressure in a tissue becomes too great, or when the tissue becomes too stiff. These diseases may worsen when cells are unable to appropriately respond the changes in their environment. In this Commentary, we discuss specific examples of how mechanical cues play a role in brain development, neural degeneration, and brain cancer.

Scientific Abstract:
All cells sense and integrate mechanical and biochemical cues from their environment to orchestrate organismal development and maintain tissue homeostasis. Mechanotransduction is the evolutionarily conserved process whereby mechanical force is translated into biochemical signals that can influence cell differentiation, survival, proliferation and migration to change tissue behavior. Not surprisingly, disease develops if these mechanical cues are abnormal or are misinterpreted by the cells - for example, when interstitial pressure or compression force aberrantly increases, or the extracellular matrix (ECM) abnormally stiffens. Disease might also develop if the ability of cells to regulate their contractility becomes corrupted. Consistently, disease states, such as cardiovascular disease, fibrosis and cancer, are characterized by dramatic changes in cell and tissue mechanics, and dysregulation of forces at the cell and tissue level can activate mechanosignaling to compromise tissue integrity and function, and promote disease progression. In this Commentary, we discuss the impact of cell and tissue mechanics on tissue homeostasis and disease, focusing on their role in brain development, homeostasis and neural degeneration, as well as in brain cancer.